

Integral monitoring of dairy cattle welfare on farm using precision livestock farming sensors

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ICAR/IDF workshop on “Sensor data to monitor and manage health and welfare”

Animal welfare assessment: **limitations**

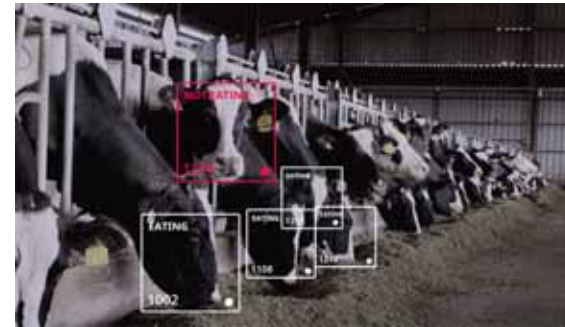


- Welfare protocols focus on **groups**
- Risk of **subjectivity**
- **Focal assessment:** provides a **(very) limited** timeframe
- **No anticipation** to welfare problems

Opportunities from emerging technologies



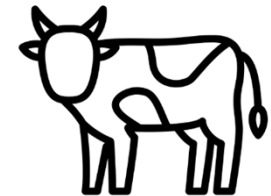
Precision
Livestock
Farming



- **Objective** assessment
- **Individual** monitorization
- **Continuous** assessment
- **Anticipating** animal welfare problems

Sensors in cattle

129



Accelerometer

Computer
vision

GPS

Scales

Thermometer

Microphone

37

10

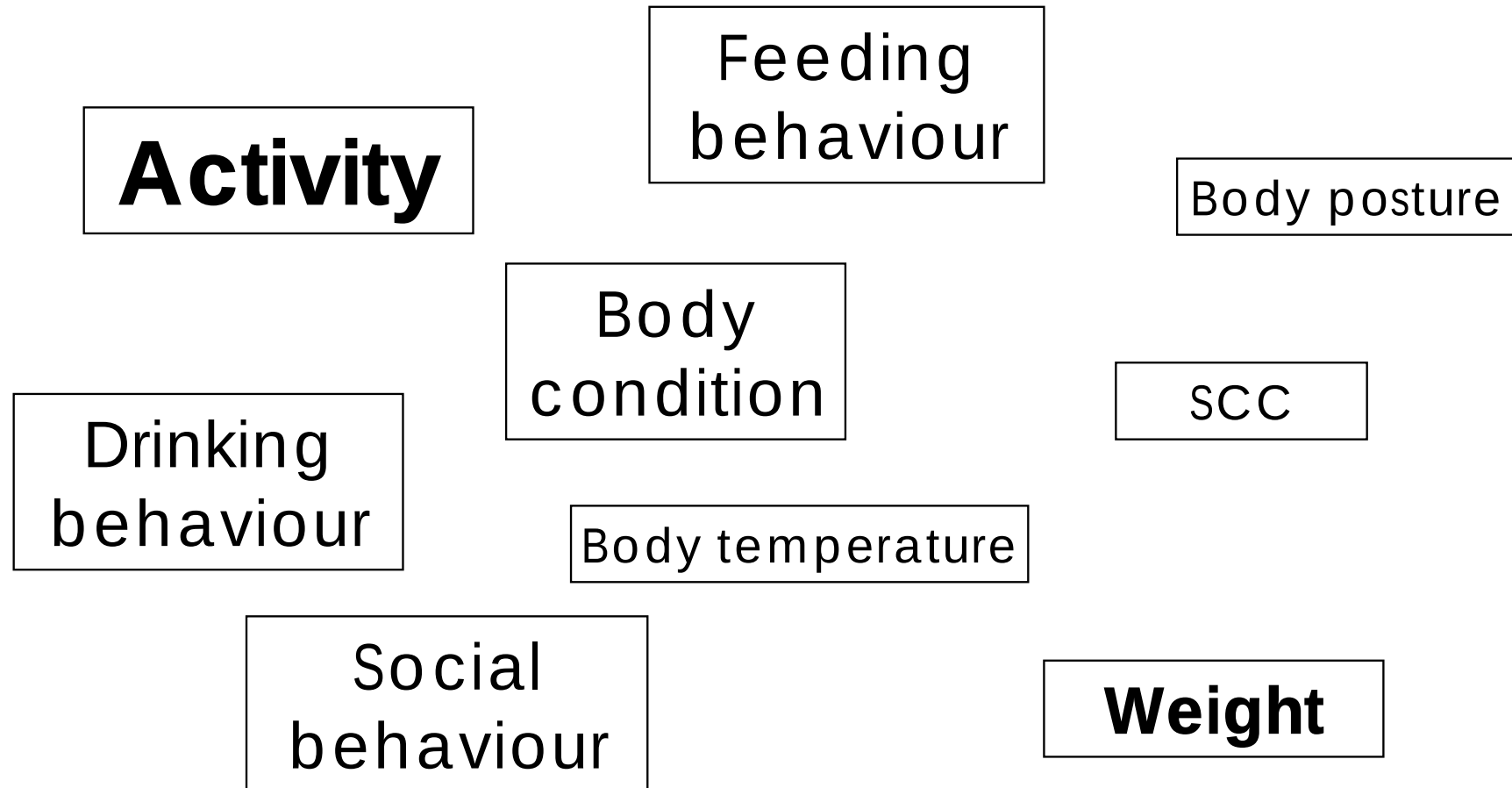
8

5

4

2

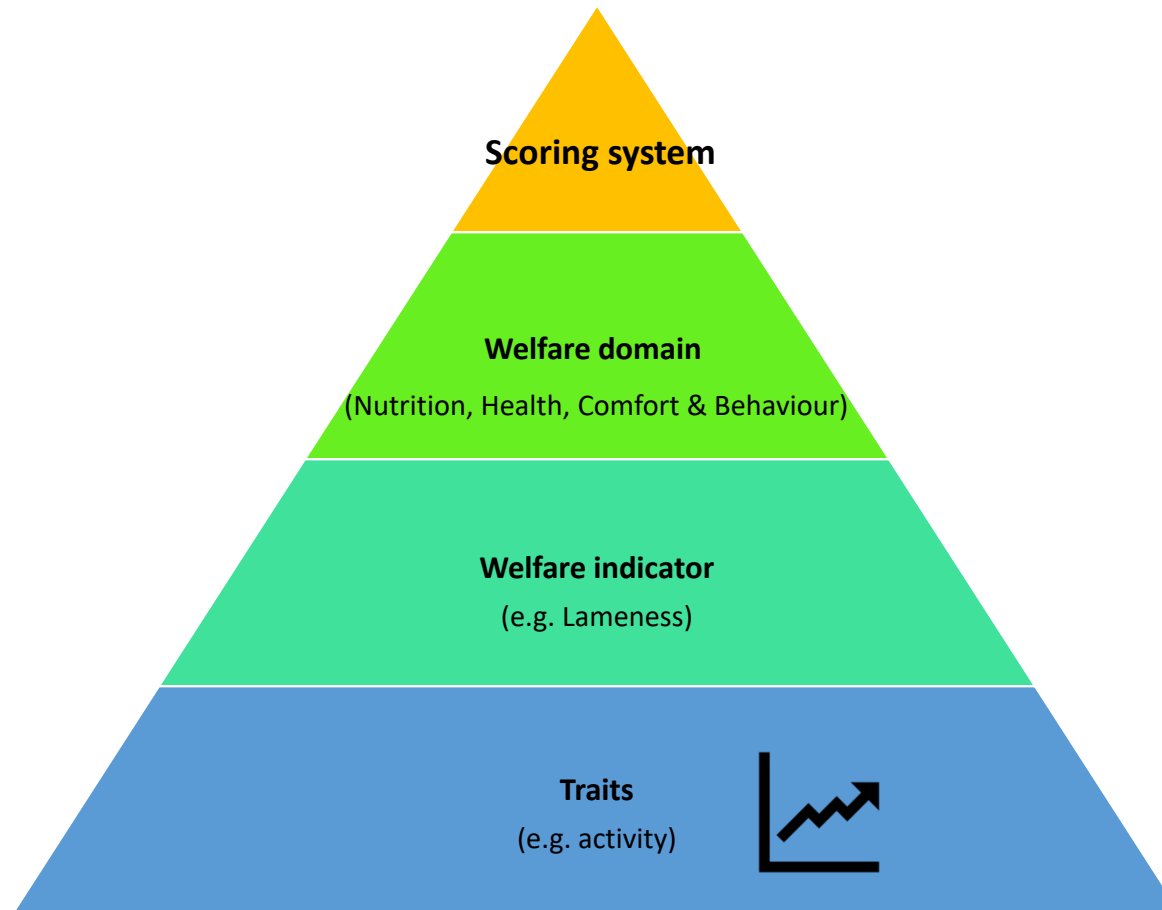
Traits provided by sensors



Sensor welfare traits: **examples**

Domain	Indicator	Behaviour trait
Comfort	Resting	Laying time
Feeding	Feeding behaviour	Rumination time
Health	Lameness	Activity
Natural behaviour	Abnormal behaviour	Stereotypes

Animal welfare assessment: new paradigm





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Research Paper

Continuous welfare assessment of dairy cows at individual level: A farmer-oriented tool based on normal daily ranges of sensor-recorded traits

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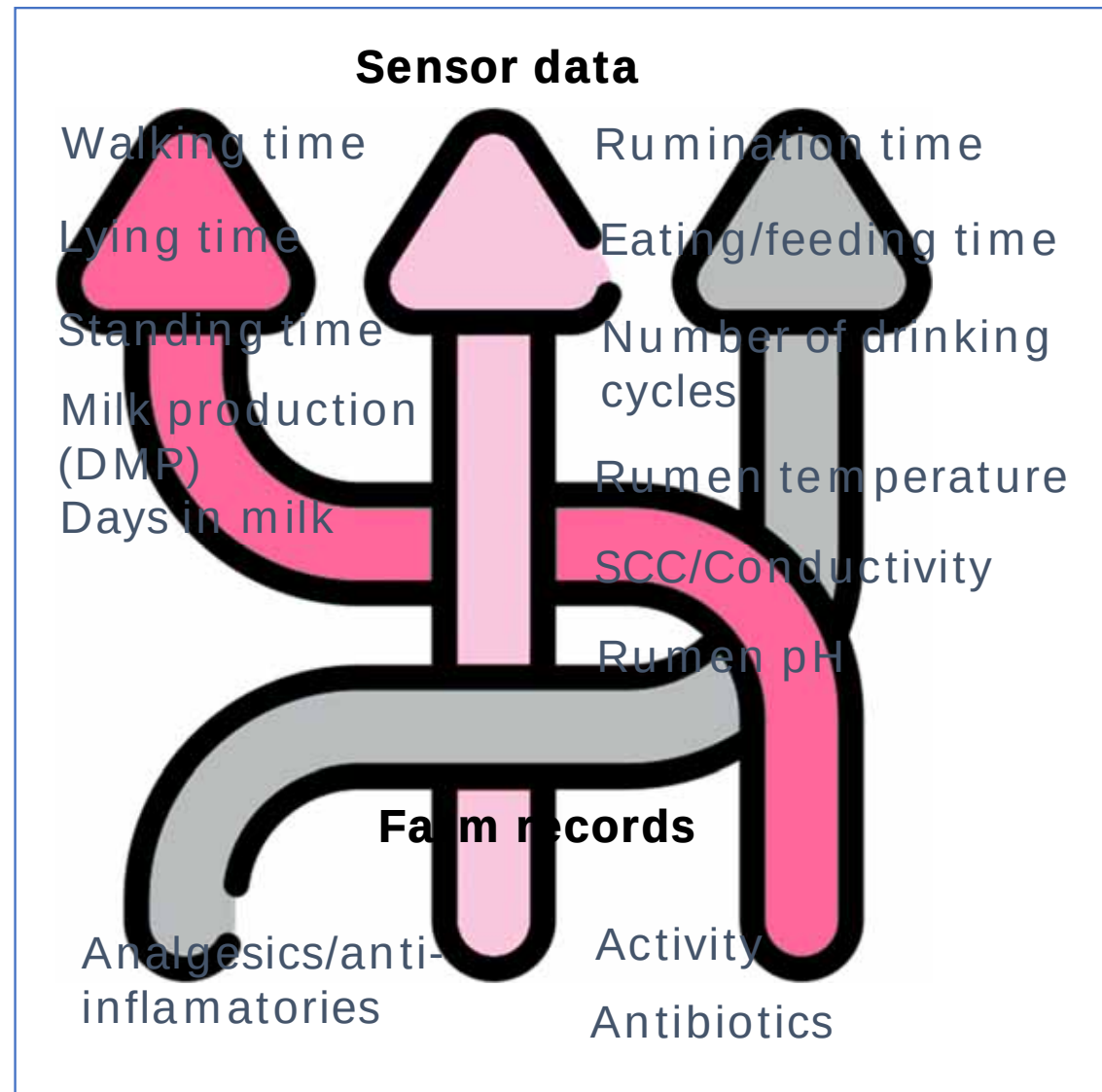
Animal welfare **data**

PLF technologies

-  Collars (Connecterra)
-  Rumen bolus (Smaxtec)
-  GPS (Herd-itt)

Other sources

-  Vet records
-  Milking robots
-  Cortisol data
-  Environment



The normal daily range approach

Within normal range = **good (1)**

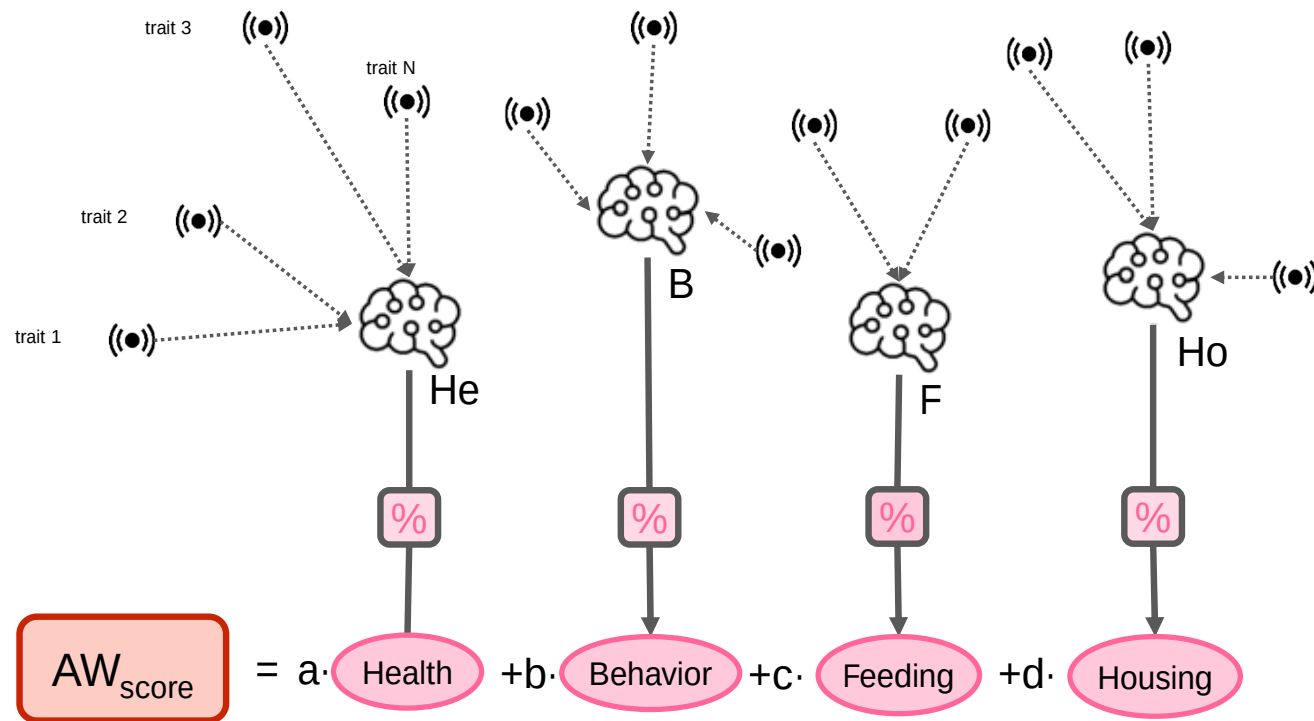
	Indicator	Min		Max	Units
Behavioural traits	Lying time	8.7		13.5	h d ⁻¹
	Rumination time ^a	335.0		602.5	min d ⁻¹
	Rumination time ^b	412.5		662.5	min d ⁻¹
	Eating time	1.1		8.1	h d ⁻¹
	Standing time	43.0		515.4	min d ⁻¹
	Walking time	0.4		3.0	h d ⁻¹
Physiological traits	Rumen pH	5.6		6.3	—
	Rumen temperature ^c	37.2		40.2	°C
	Drinking times	4.5		7.6	d ⁻¹
Productivity rates	Milk conductivity	>5		—	mS/cm
	Somatic cells count	0		200000	no./mL

The normal daily range approach

Out of range = **bad (0)**

	Indicator	Min	Max	
Behavioural traits	Lying time	8.7	13.5	h d ⁻¹
	Rumination time ^a	335.0	602.5	min d ⁻¹
	Rumination time ^b	412.5	662.5	min d ⁻¹
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	Drinking times	4.5	7.6	d ⁻¹
Productivity rates	Milk conductivity	>5	—	mS/cm
	Somatic cells count	0	200000	no./mL

Aggregation of animal welfare data



Integration of animal welfare data

Cow 1

```
1 cow_data_day(43582, '2021-02-01')

=====
Feeding Score: 7.5
Housing Score: 7.5
Health Score: 8.89
-----
Total Score: 7.96
=====
eating: 7834.69
ruminating: 14133.38 - Smaller than 15720
temperature: 38.74243
drinking.times: 6.0
lying: 17988.46
standing: 20738.99
walking: 7523.18
pH: 5.93153
SCC: nan - No data
```



Cow 2

```
1 cow_data_day(101371, '2022-08-29')

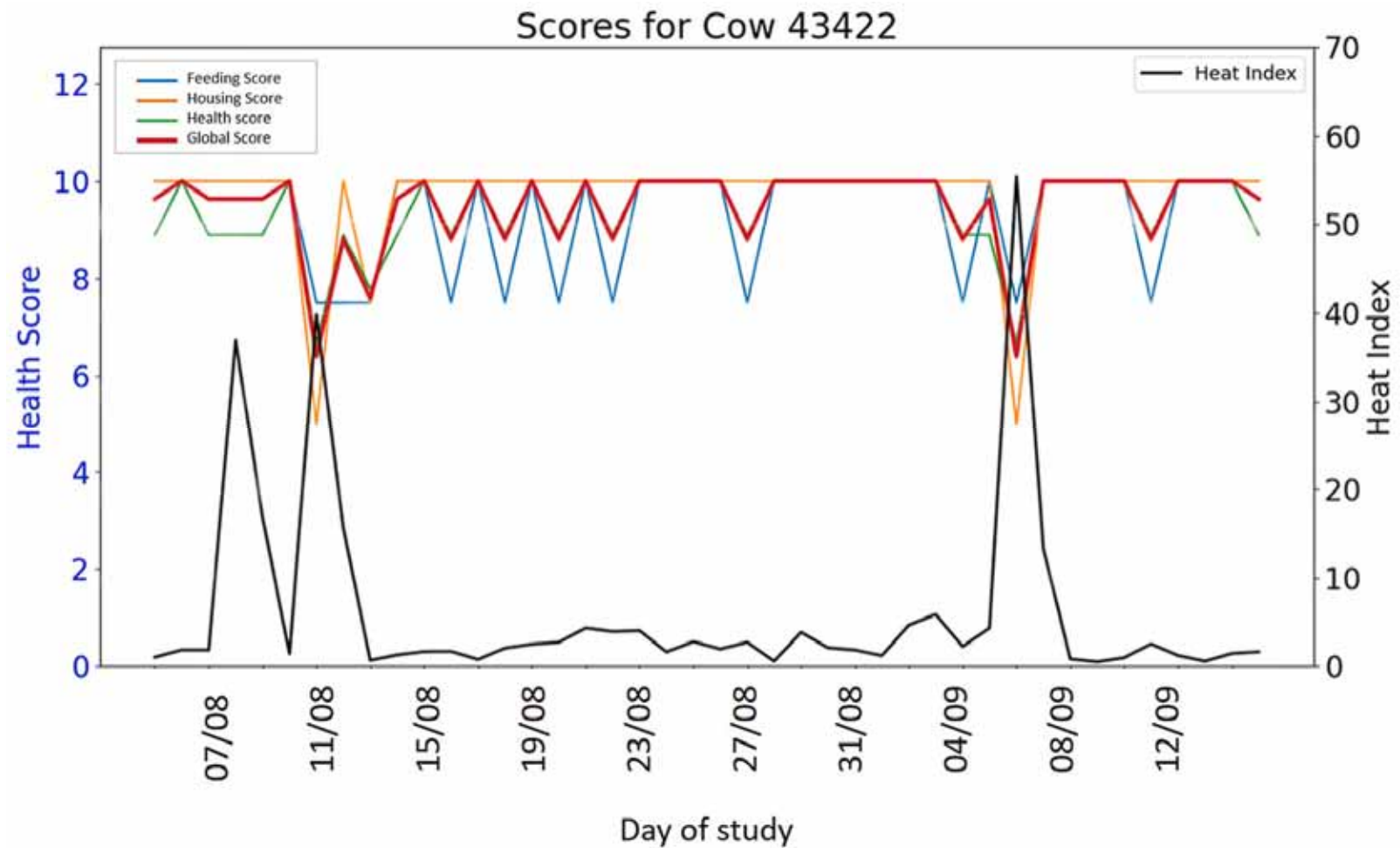
=====
Feeding Score: 10.0
Housing Score: 10.0
Health Score: 10.0
-----
Total Score: 10.0
=====
eating: 17582.69
ruminating: 29606.23
temperature: nan - No data
drinking.times: nan - No data
lying: 20849.72
standing: 56180.38
walking: 9316.55
pH: nan - No data
SCC: nan - No data
```



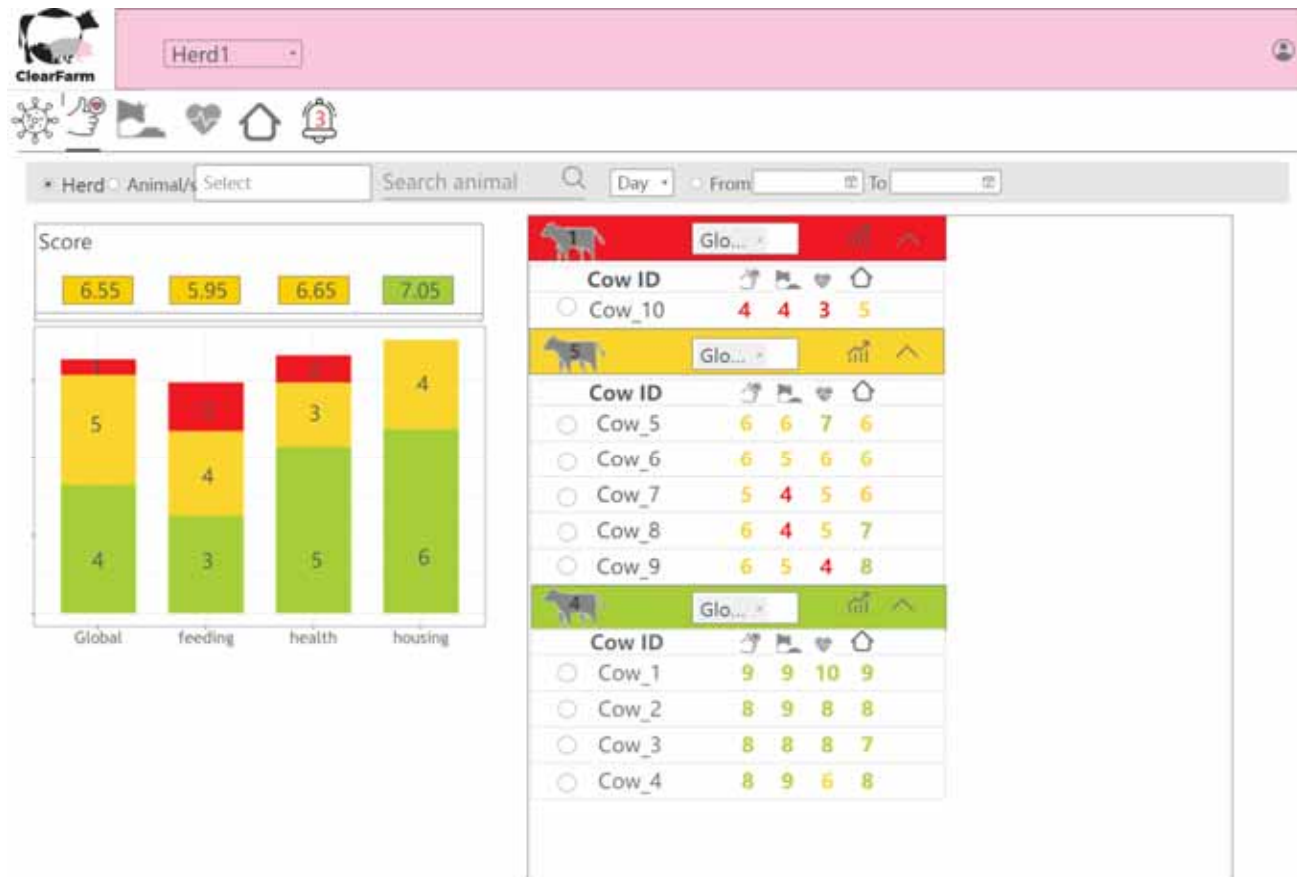
'n' cows

...

Integration of animal welfare data



Integration of animal welfare data



Remarks about PLF to monitor welfare

- PLF is a **new paradigm** of animal welfare assessment, based on objective, systematic and continuous evaluation
- Changes in **behaviour, physiology and performance** can now (PLF) be assessed, with potential to monitor **animal welfare**
- The **normal daily ranges** can be used to transform PLF traits into animal welfare information
- PLF traits can be **integrated** to provide a thorough 5-domain welfare assessment

Acknowledgements



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